Biology | 2014-2015 Assessment Report

1. Please give a brief overview of the assessment data you collected this year. This can be in any form you feel is appropriate, such as a table, a short narrative of results, statistical analysis, highlighting findings that were of particular interest, etc. You will, however, likely want to submit results for each learning outcome you assessed this year individually.

Our goal this year was to evaluate Biology Learning Outcome 2: Demonstrate an understanding of genetic information, hereditary processes, and their relevance to evolutionary change as a product of mutation and natural selection.

Our initial plan was to evaluate this learning outcome with imbedded assessments in several core courses, but we discovered a more systematic approach described in a recent thesis by Jaksetic (2012) and a related, earlier paper by Nehm and Reilly (2007). This new approach was desirable because it provides quantitative data for comparisons with results from students in at least one other institution (Bowling Green State University) and it covers a wider range of concepts associated with Learning Outcome 2.

Three open ended questions were given to students in the required course, Biology Seminar (BIOLOGY 490) during spring semester 2015. These questions, designed by Jaksetic (2012) and colleagues in order to assess students' understanding of genetic variation, natural selection, and the relationship between the two.

Please answer the following three questions to the best of your ability:

1. Elastin is the name of a protein found in human tissues. Most people have elastin proteins that have a shape that is straight, like this: _____
   In some people, the elastin proteins have a shape that is bent, like this: _____/
   Explain how elastin can have different shapes in different people.
2. Certain diseases in humans are caused by a single change in a person's DNA sequence. In one such disease, people have extreme muscle weakness. Individuals with this disease have a single nucleotide base change in the DNA sequence that encodes the protein called dystrophin. For example:
   ATTCGCCCGGAATTAAGAGTGAGG is changed to: ATTCGCCCGAAATTAAGAGTGAGG.
   The function of dystrophin is to bind to muscle fibers. This helps to stabilize and strengthen the muscle fibers. How can a single change in the dystrophin DNA sequence lead to weakened muscles?
3. Cheetahs (large African wild cats) are able to run faster than 60 miles per hour when chasing prey. How would a biologist explain how the ability to run fast evolved in cheetahs, when the cheetahs' ancestors could run only 20 miles per hour?

As part of her PhD dissertation at Bowling Green State University, Jaksetic developed a scoring system that takes into account each student's use of key concepts identified by Hawley et al. (2011). Students' were penalized for using incorrect concepts. Example of key concepts include 1) DNA contains

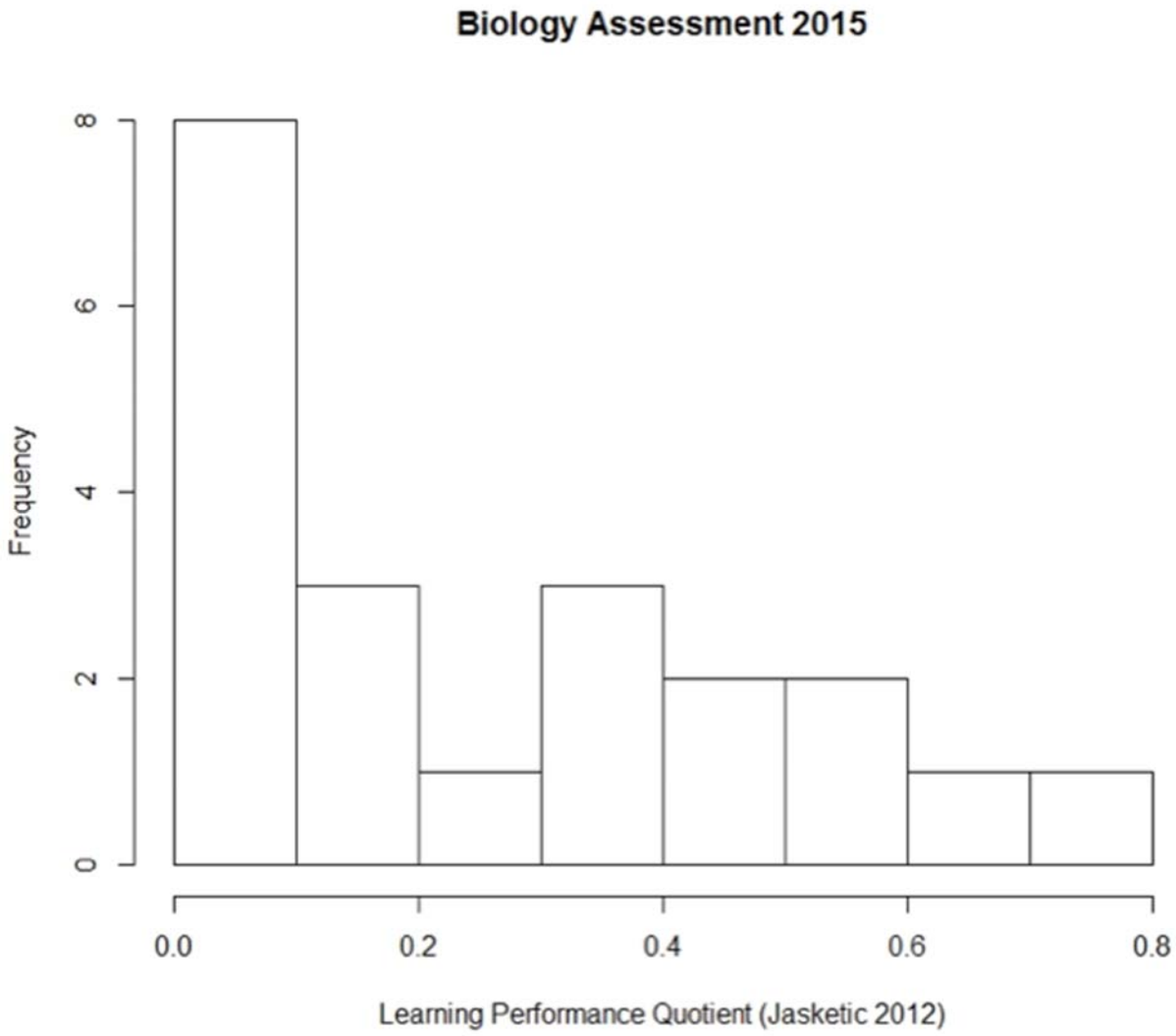
instructions for building proteins; 2) Mutations can lead to changes in protein function; and 3) Some of the variation in natural populations is heritable. The index used for scoring (Learning Performance Quotient or LPQ) used the following formula:

$$\text{LPQ} = \frac{\text{\# of key concepts}}{\text{\# of key concepts + alternative concepts}} \times \frac{\text{\# of key concepts}}{\text{total possible key concepts (=10)}}$$

A perfect score of 1.0 is obtained by including all of 10 key concepts with no alternative or incorrect concepts.

Results

The mean LPQ of UWGB students in the spring 2015 Biology Seminar (n=22) was 0.265, within the ranges of 0.21 and 0.29 for students at Bowling Green University. Only 10 students, however, scored higher than 0.2, suggesting that although some students did extremely well, a significant number of students performed poorly on this assessment.



2. How will you use what you've learned from the data that was collected? Some examples are: particular improvements to the curriculum, incorporation of a different pedagogy, a change in assessment plan for the following year in order to obtain more specific feedback, better information or a better response rate, a determined need for faculty development in a particular area, better career alignment, a faculty retreat to discuss the data and how best to use it, etc.

Although students in Biology Seminar are juniors and seniors, we have no information regarding their academic histories. Some of these might not have taken core courses such as Evolutionary Biology, Genetics or Principles of Ecology, where key concepts would have been covered. If we decide to administer this assessment tool again, we should gather information about which courses each student has previously taken.

Clearly, these results indicate that some students in our program have a poor grasp of the concept of evolution and the relationship between genetics and natural selection. These are not easy concepts, so

additional teaching efforts are warranted to reinforce these important concepts, which lie at the very foundation of modern biology.

References

Nehm, R.H. and L. Reilly. 2007. Biology majors' knowledge and misconceptions of natural selection. BioScience 57(3): 263-272.

Hawley, P.H., S. Short, L. McCune, M. Osman, and T. Little. 2011. What's the matter with Kansas?: The development and confirmation of the Evolutionary Attitudes and Literacy Survey (EALS). Evolution: Education and Outreach 4.1: 117-132.

Jaksetic, J.M. 2012. Assessing student understanding of the connection between DNA and evolution. M.S. Thesis, Bowling Green University.